customs too frequently lead, this second object is at present attained.

It is almost ludicrous that at the very moment when a Royal Commission is sitting to determine the constitution of a new University for London, Parliament should be asked to sanction a Bill which, if it serves as a precedent, may make the teaching of some of the most important sciences impossible within the metropolitan area. Indeed, in this danger we find a new confirmation of the importance of the policy which we have often urged upon those who are directly interested in the constitution of the future University.

Science teaching in Exhibition Road is threatened to-day. It may be threatened somewhere else to-morrow. It will be impossible for a number of competing colleges to defeat the railway engineers, or to preserve intact for scientific research a number of buildings planted upon sites selected without reference to the new danger which has arisen. They will be attacked in detail, and beaten one by one. How immensely in this, as in many other matters, would their position be strengthened if they were able to speak with one voice in support of a plan decided on in common, and defended together. If the hoped-for University of the future already existed; if it spoke with the prestige of the existing University of London, combined with that of the consolidated teaching staffs of the London Colleges; if the support of a Government Department could be asked to aid a University which, like the British Museum, commanded universal respect and support; then it might be possible to obtain a ready hearing for opinions given with all the weight of a great institution of which the country would be justly proud. Till the union is effected, which alone will make science in London able to meet its enemies in the gate, we must struggle as best we can to prevent irreparable mischief.

We can only hope that the Vice-President of the Council, who is known to have the interests of the higher education at heart, will not allow a railway, electrical or other, to injure the teaching institutions clustered round the magnificent collections of apparatus in his charge.

SOUND AND MUSIC.

Sound and Music. By the Rev. J. A. Zahm, C.S.C., Professor of Physics in the University of Notre Dame. Large octavo, 452 pages. (Chicago: A. C. McClurg and Company, 1892.)

THIS handsomely got-up and lavishly illustrated volume is, the author informs us, a largely expanded transcript of a course of lectures delivered by him, in 1891 "in the Catholic University of America, at Washington, D.C." Its "main purpose is to give musicians and general readers an exact knowledge, based on experiment, of the principles of acoustics, and to present at the same time a brief exposition of the physical basis of musical harmony." A clear intimation is given at the outset (p. 18) of the predominant *rôle* which experiment is to play in the acoustical portion of the undertaking. Had Prof. Zahm not had at his disposal "all the more delicate and important instruments" of research and verification, in the theory of sound, constructed by Dr. Koenig of Paris, he would "not have attempted to give the present lectures on sound" before such an audience as that which actually attended them. With Dr. Koenig's apparatus around him, however, he had assured means of "entertaining" his hearers, and of "illustrating in a way that would otherwise be impossible the most salient facts and phenomena of sound." The late Isaac Todhunter has deprecated the systematic repetition of perfectly established experiments, on the ground that their results ought to be believed on the statements of a tutor—"probably a clergyman of mature knowledge, recognised ability, and blameless character" to suspect whom was in itself irrational.[1] Prof. Zahm's practice pushes to a great length a view directly opposed to that enunciated—with obvious humorous exaggeration—by the well-known Cambridge private tutor. Not content with a single experiment decisive of each successive issue presented, he performs a whole series bringing into action all the resources of his superbly found collection of acoustical apparatus. It is no detraction from the clear and interesting manner in which these formidably numerous experiments are set forth, to say that the amount of space necessarily devoted to explaining the mechanism of the apparatus used gives to parts of Prof. Zahm's volume somewhat of the look of an acoustical instrument-maker's illustrated catalogue. Subject, however, to this defect, if defect it be, the lectures are decidedly pleasant and attractive reading. The illustrations, too, are thoroughly clear and beautifully executed, so that our author may be fairly congratulated on success in 'entertaining'—the word is his own—his hearers and readers. His object, to give to general readers an "exact knowledge" of the principles of acoustics, has also been in a fair measure attained, but subject to certain not inconsiderable deductions. In describing the processes and results of experiment Prof. Zahm is clear and thoroughgoing: in expounding the parts of acoustical theory which must be mastered if the facts thus obtained are to be understood in their mutual relations, he is often vague and superficial. Thus the nature of wave-motion, the formation of stationary undulations, the composition of small vibratory movements—matters of crucial importance to any connected comprehension of Acoustics—receive from him no effective elucidation. Nay, he is even chargeable with having, by the misuse of a technical term of perfectly settled meaning, written in a way likely to confuse his readers' ideas on these very matters. On p. 46 he calls certain points in a series of progressive waves "NODAL points where there is no motion," thus confusing two things which ought to be most carefully distinguished from each other, a point of *momentary* rest in a *progressive wave*, and one of *permanent* rest in a *stationary undulation*. The usage which restricts 'node' to this latter meaning is so well established that such use of it as the above is quite inexcusable, especially in an author who himself elsewhere, p. 146 &c., employs it in its ordinary signification. The same indifference to accuracy of expression recurs in this volume with a frequency not creditable to a professor of an exact science. Thus on p. 50 the return movement of a prong of a tuning fork is said

---

[1] "The Conflict of Studies," p. 17.

© 1893 Nature Publishing Group

to ‘pull’ air particles apart. On p. 52 we are told that the motions of particles of a water wave “are always at right angles to the direction of the wave itself.” On p. 68 the author corrects this statement, but in doing so, takes occasion to speak of a plane “in,” instead of ‘passing through’ the line of progression. On p. 380 he describes harmonic partial-tones as “modifying the quality of their fundamental,” though he obviously means the quality of the compound sound due to the fundamental and other partial-tones combined. On p. 387 it is said that the “ratios of frequencies” which characterize particular sounds “are called intervals,” and that by dividing one note by another we obtain the intervals between them. Language of this kind is, indeed, hardly misleading, but it is certainly very slipshod.

Before passing from the more generally acoustical, to the more specially musical portion of Prof. Zahm’s volume, it is proper to point out one important respect in which it has the advantage over most, or possibly all, the manuals on the same subject which have preceded it. This merit consists in giving a somewhat full account of elaborate experimental researches on beats, combination-tones and quality conducted by Dr. Koenig, the results of which are to a considerable extent at variance with conclusions previously announced by Prof. Helmholtz. In the opinion of our author, Dr. Koenig is “one who, not excepting even the eminent German philosopher just mentioned (Helmholtz), has contributed more than any other person to the advancement of the science of acoustics” (p. 17). A more balanced judgment, while placing great reliance on Dr. Koenig’s experimental skill and on the superlative excellence of the apparatus constructed by him, would probably attribute to Helmholtz’s opinion a preponderant weight in interpreting and correlating the results of experiment. Be that, however, as it may, Prof. Zahm has done excellent service by popularizing the work so laboriously performed, and so modestly placed on record, by the eminent instrument-maker to whom no one who has put his hand to acoustical work can fail to be under considerable practical obligations.

The specifically musical are decidedly the least meritorious parts of our author’s performance. The looseness of phraseology already complained of is here at its worst. On p. 166 we are told that a ‘comma,’ ($\frac{81}{80}$) is “the smallest interval used in music.” A beginner might easily take this to mean that notes differing by only that interval were actually heard consecutively in a musical phrase—of course an absurd supposition. Very misleading, again, is the statement on p. 388 that tones, like major and minor tones, that differ from each other only by a comma “are considered in music to have the same value.” The only rational meaning to be got out of it seems to be that *in the equally tempered scale* the distinction between major and minor tones is obliterated On p. 389 the notes of the diatonic scale, and their relations, in respect to rapidity of vibration “to one another,” are set out, and it is added that all but the second and the seventh of the intervals thus indicated are consonant. The essential piece of information, that it is not the intervals formed by these notes with “one another,” but with *the tonic*, that are in question, is withheld, and so the reader is left free to suppose *e.g.* that the tritone, F—B, is a consonance. On p. 390 the ‘inversion’ of intervals is mentioned without any explanation of its meaning.

Attention may well be called to a process of reasoning which occurs on pp. 388–390. Prof. Zahm abruptly introduces (p. 388) calculation by “frequency-ratios”; assumes, without attempt at proof, that addition of two semitones is performed by squaring the ratio $\frac{16}{15}$, and then remarks (p. 390) “From the foregoing we observe that the sum of two intervals is obtained by multiplying, not by adding their ratios together.” An *assumption* in a *particular case* is thus made to do duty as a *general demonstration.*

On p. 396 we read that “so perfectly does the interval of the fifth answer the requirements of the ear that even unpractised singers find it quite natural to take a fifth to a chorus that does not quite suit the pitch of their voice.” If, as this passage appears to suggest, practised singers in America find it still more natural to accompany melodies in consecutive fifths, wonderful effects may surely be expected from the choruses to be heard at the Chicago exhibition.

On p. 429 our author describes a diagram by Helmholtz as concerned with the transposition of an interval by an octave, whereas what it really deals with is the enlargement of the interval in question by the addition to it of an octave. On p. 430 he writes down, *as constituents of the chromatic scale of C*, the notes E♯, F♭, B♯ and C♭.

On p. 441, he tells us that in listening to such violin players as Joachim, Wilhelmj, and others “one can always hear distinctly the *Tartini*, or beat-tones, that add such richness and volume to violin music.”

To gauge the amount of truth contained in this remark it suffices to bear in mind that in the case of most major, and of all minor consonant chords, Tartini’s tones cause a *decided dissonance.* Players who made them ‘always distinctly audible’ would soon be reduced to permanent inaudibility themselves.

Prof. Zahm’s volume is creditably free from misprints: the following have, however, been noted:

P. 23, l. 16 ‘period’ for ‘periods.’
P. 68, l. 21 ‘amplitude’ for ‘amplitudes.’
P. 90, l. 8 ‘Ajugari’ for ‘Agujari.’
P. 142, in diagram, B_4♯ for B_4.
P. 152, in diagram I, B♯ for B.
P. 388, ll. 11 and 12, G for F.

GERLAND’S ETHNOLOGICAL ATLAS.

Atlas der Völkerkunde. (Berghaus’ Physikalischer Atlas, Abth. vii.). Bearbeitet von Dr. Georg Gerland, Professor a.d. Universität in Strassburg. (Gotha: Perthes, 1892.)

ANTHROPOLOGY owes much to Prof. Gerland, whose completion of the two last volumes of the late Prof. Waitz’s “Anthropologie der Naturvölker” is a monument of that co-ordinated knowledge of fact which is the source of sound principle. His new “Atlas of Ethnology,” while forming part of the great Physical Atlas of Berghaus, may be obtained and used as a separate work by anthro-

© 1893 Nature Publishing Group